BUILDING FRAME MEMBER

Cross-Reference to Related Application

[0001] This application claims the benefit of U.S. Provisional Application No. 60/444,818, filed February 4, 2003.

Background of the Invention

[0002] This invention relates to a building frame member such as a roof truss or hip rafter.

[0003] Roof trusses generally comprise a bottom chord and at least one (and more commonly two or more) obliquely arranged top chord. A web defined by a plurality of web members extends between the bottom chord and the top chord. When the truss is installed in a building, some of the web members are subjected to compressive forces which can cause the web members to bend or flex out of the plane of the truss. The bending or flexing weakens the truss and can lead to total failure of the truss.

[0004] In order to prevent the web members from bending or flexing, web members are reinforced in a number of different ways. One method is to tie the web members together. Other methods use a reinforcing member, such as a brace. However, conventional methods of reinforcing the truss make truss manufacture more difficult, particularly when the truss is formed in a semi-automated fashion. For example, some reinforcing members have integral, punched teeth for attaching to web members. The teeth are pressed into web members by a floating press, i.e., a clamp suspended from an overhead carriage for movement between several splice pedestals supporting the web members and chords in assembled position. Unfortunately, it takes substantial time for an operator to attach the reinforcing members. The teeth require multiple, repetitive press cycles by the floating press at each of several positions along the reinforcing member. Further, it can be difficult or impossible for operators to reach the press into

positions at the interior of the truss. An additional difficulty is that a portion of each reinforcing member typically extends beyond the confines of the truss. Because the reinforcing member is attached to a side of the web member which faces out of the plane of the truss, it extends to a thickness greater than a thickness of the truss. Consequently, the reinforcing member interferes with stacking or nesting of assembled web members and completed trusses during handling and transportation. Further, the reinforcing member is subject to being crushed.

Summary of the Invention

[0005] Among the objects of the present invention is the provision of a building frame member which is suitably reinforced with minimum disruption to the normal manufacturing process, particularly if a floating press-type system is used to form the frame member; the provision of a brace secured to a web member by a separate fastener such that the web member can be manufactured in the normal fashion and the brace simply connected in a separate operation which does not interfere with the construction of the frame member; and the provision of a brace which is entirely within the confines of the truss.

[0006] In general, a structural truss according to the present invention comprises a plurality of structural members arranged in a configuration defining a plane. A web including at least one web member extends between two structural members within the plane. The web member has first side portions generally defining a front side and an opposite back side which face opposite directions substantially out of the plane, and has second side portions located between the first portions which generally define opposite lateral sides which face opposite directions substantially within the plane. A brace is secured to the web member for reinforcing the web member, the brace engaging the web member at one of the lateral

sides. At least one fastener secures the brace to the web member, the fastener penetrating the web member at one of the lateral sides. The front and back sides of the web member remain free from fasteners.

[0007] Other objects and features will be in part apparent and in part pointed out hereinafter.

Brief Description of the Drawings

[0008] Preferred embodiments of the invention will be described, by way of example, with reference to the accompanying drawings in which:

[0009] Figure 1 is a perspective view of a brace used in the preferred embodiment of the invention;

[0010] Figure 2 is a cross-sectional view through the brace of Figure 1;

[0011] Figure 3 is a view of a truss according to one embodiment of the invention; and

[0012] Figures 4-17 are cross-sectional views of embodiments of the invention showing various different brace configurations.

[0013] Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Detailed Description of the Preferred Embodiments

[0014] With reference to Figures 1 and 2, a reinforcing member, or brace 10, according to the present invention is shown. The brace 10 includes a base 12 and a pair of side walls 14 and 16 which extend from the base 12 and are separated by the base 12. The walls 14 and 16 are generally parallel and extend in the same direction at right angles with respect to the base 12. The walls 14 and 16 have in-turned flanges 18 at their free ends.

[0015] The base 12 is provided with a plurality of holes 20 along its length. In the embodiments shown, three such holes are provided but a different number of holes could be used if desired.

[0016] The brace 10 typically has a length of 1.5 meter to 3 meters. If desired, sets of braces in stock lengths could be provided so that a suitable length can be selected for connection to a web member depending on the length.

[0017] Figure 3 shows one embodiment of the frame member in the form of a building truss which has structural members arranged in a plane. The truss includes a bottom chord 30, two oblique upper chords 32, and a web comprising web members 33 and 35 extending between the chords. The configuration of the truss is standard and, as is well known, the exact location of the web members will vary depending on the configuration and intended use of the truss. The web members 33 generally form tension web members which will be subjected to tensile forces when the truss is in use. The web members 35 will generally form compression web members which will be subjected to compression forces when the truss is in use. To prevent the compression web members 35 from bending or flexing out of the plane of the truss, braces 10 according to Figures 1 and 2 are connected to the web members 35. In the embodiment shown, the web members 35 are formed from wood and have a generally rectangular cross section.

[0018] Figure 4 is a cross-sectional view through one of the web members 35 of Figure 3 showing the brace 10 secured to the web member. The web member 35 has first side portions including a front side 35a and a back side 35b which face opposite directions substantially out of the plane of the truss. Second side portions include lateral sides 35c and 35d which face opposite directions substantially within the plane of the truss. The section view of the web member shown in Fig. 4 is oriented with lateral sides 35c and 35d positioned as the bottom and top surfaces, respectively. The brace 10 is secured in place by screws or nails 40 which are hammered or screwed through the holes 20 and which penetrate the web member 35, as shown in Figure 4.

[0019] Significantly, the screws or nails 40 are distinct and non-integral with the brace 10. Therefore, the web member and brace may be attached prior to a truss manufacturing process. During that process, there is no need for an operator to reach a floating press to an interior position of the truss, nor any need for repetitive press cycles such as when embedding punched teeth in web members. Thus, the truss manufacturing process is more efficient.

[0020] Although the brace 10 is attached to the side 35c of the web member 35, it could be connected to a different side of web member 35. Connecting to sides 35c or 35d locates the brace 10 within the thickness confines of the truss, that is, within a region bounded by parallel planes corresponding to front and back sides 35a and 35b which are spaced apart by the maximum spacing between front and back sides. The brace is positioned entirely between vertical side faces of the chords and web members of the truss when located in position in a building. The brace 10 does not project beyond the vertical side surfaces 35a and 35b of the web member. This arrangement therefore has the advantage that no part of the brace extends beyond the confines of the truss, and the brace will not be crushed nor interfere with stacking of web members or completed trusses. If the brace 10 were connected to sides 35a or 35b or had any portion overlying sides 35a or 35b, a disadvantage is that the brace would project out of the confines of the truss which makes transportation, handling, and stacking of trusses more difficult.

[0021] Figure 5 shows an embodiment similarly to Figure 4, but of a configuration in which the brace 10a has a base 12a, a first side wall 14a and a second side wall 16a which extends in a direction opposite the side wall 10a. The wall 14a has in-turned flange 18a, but it will be noted that the wall 16a does not have a flange. The brace 10a is secured to the web 35 by a nail or screw 40 in the same manner as previously described.

[0022] In the embodiment of Figure 6, the brace 10b is somewhat similar to the brace 10 of Figure 4, except that the side walls 14b and 16b converge towards one another, and have outwardly turned flanges 18b at their free ends. The brace 10b is secured to the web 35 in the same manner previously described by locating nail or screws 40 through holes in base 12b.

[0023] In the embodiment of Figure 7, the brace 10c is of the same configuration as the brace 10 of Figure 4, except that the in-turned flanges 18 are not included. In this embodiment the brace is connected to the web 35 so that the web is received between the side walls 14c and 16c. Screws or nails 40 passes through holes in base 12c to secure the brace in place.

[0024] In the embodiment of Figure 8 the brace 10d is in the form of a relatively wide wall 16d, a base 12d and a relatively short side wall 14d. The wall 14d has an in-turned flange 18d. Holes (not shown) are provided along the length of the longer wall 10d and screws or nails 40 locate through the holes to secure the wall 10d to the web 35. The base 12d is spaced from the web 35 by the in-turned flange 18d and the short side wall 14d.

[0025] In the embodiment of Figure 9 the brace 10e has a wide base 12e which is wider than the width of the web 35, a side wall 14e, a side wall 16e, and wherein the side walls 14e and 16e are spaced apart by the base 12e. The side walls 14e and 16e are generally parallel and extend in the same direction. In this embodiment the web 35 is received within the brace between the walls 14e and 16e and with the base 12e flush with one of the vertical faces of the web 35. The base 12e has holes as in the earlier embodiments and the brace 10e is secured to the web 35 by nails or screws 40 which pass through those holes and penetrate into the web 35. The wall 14e has an in-turned flange 18e and the wall 16e may optionally have an in--turned flange 18e.

[0026] Figures 10 and 11 show embodiments of the invention in which the web 35 is in the form of a metal web formed from tube and having a generally circular cross-section. The thickness confines of the truss for these embodiments is generally within a region bounded by planes defined by outermost lateral position of side portions 35a and 35b.

[0027] In the embodiment of Figure 10, the brace 10f is of generally the same shape as the brace 10 of Figure 4. However, in this embodiment the metal web 35 is received within the brace 10f between the side walls 14f and 16f. The brace 10f is secured to the metal web 35 by a screw 40' which passes through holes along base 12f of the brace 10f and which screw into the web 35. The web 35 may be pre-drilled or the screw 40' may simply tap the web 35 in order to secure the brace 10f to the web 35. In this embodiment the walls 14f and 16f have in-turned flanges 18f which have end portions 19f which are bent more than 90 degrees with respect to the walls 14f and 16f so that they are directed towards the web 35.

[0028] In the embodiments of Figures 4 to 10, the base of the brace is flat.

[0029] In the embodiment of Figure 11 the brace 10g has a base in the form of a curved transition section 12g which joins with the side walls 14g and 16g. The side walls 14g and 16g have in-turned flanges 18g which are the same as those in the embodiment of Figure 10. Once again, the base 12g is provided with a plurality of holes which are the same as the holes 20 shown in Figure 1, through which screw 40' can locate so as to secure the brace 10g to the web 35 in the same manner as in the embodiment of Figure 10.

[0030] Although the embodiments of Figures 4 to 11 have been described with reference to web members 35 of a truss of the type shown in Figure 3, the invention is applicable to other frame elements such as hip rafters and braces of the same configuration as those described with

reference to Figures 4 to 9 can be secured to a hip rafter in exactly the same manner as described with reference to Figures 4 to 9, so as to reinforce the hip rafter and prevent the hip rafter from bowing in a vertical plane when loaded.

[0031] Figure 12 shows a still further embodiment of the invention. In this embodiment the brace 10h includes a base 12h which extends within the confines of the truss. The base 12h has an inwardly directed V-shaped flange 18h at each end. The fastener 40 for securing the brace 10h to the web 35 passes through the base 12h between the flanges 18h.

[0032] In Figure 13 the brace 10i has a side wall 16i and a V-shaped flange 18i at one end. The flange 18i has an in-turned base wall 12i which sits generally flush with face 35c of the web 35. Fastener 40 extends through the wall 16i to join the brace 10i to the web 35.

[0033] Figure 14 is similar to Figure 13, except that both ends of the wall 16i are provided with flanges 18i with in-turned base walls 12i.

[0034] Figures 15-17 show an embodiment similar to that of Fig. 4 which has flexibility in that it may be used with either rectangular or circular web members. Brace 10k has a flat base 12k with side walls 14k and 16k extending from the base. Flanges 18k are provided to give the brace greater strength. The flanges are inwardly turned by about 180 degrees, thereby providing a wider spacing between the flanges than would a smaller turn to permit ready access for inserting screws 40 (Fig. 15) or for receiving web member 35 (Figs. 16 and 17). As shown in Fig. 15, the brace 10k remains within the thickness confines of the rectangular web member, and the side walls project outward from the web member 35. Figs. 16 and 17 show the brace 10k attached to circular web members of two differing diameters, with the web members received between the side walls. An angled end 19k provided on each flange 18k engages the web member. The brace engages and is secured

to one of the lateral sides 35c or 35d so that the front and back sides 35a and 35b remain free from fasteners. Therefore, the assembled web members and trusses can be firmly stacked, and the reinforcing members and screws or nails will not be crushed.

[0035] The embodiments of Figures 4, 6, 12 and 15 have the advantage that the brace 10 is within the confines of the truss to facilitate stacking or nesting of web members and also manufactured trusses.

[0036] Furthermore, in some embodiments the brace functions to prevent buckling by increasing the moment of inertia. A portion of the mass of each brace is placed at a distance from the centroid of the web, which increases critical buckling load for a given length web. Embodiments which have: (a) greater mass, or (b) further distance from the web, such as flanges at positions of extremity, provide additional strength benefits relative to embodiments of lesser mass and where the brace is closely adjacent to the web.

[0037] The various embodiments provide various relative advantages and may be selected for use according to the particular frame member and/or preference of the operator. For example, embodiments such as in Figs. 7-11, 13, 14, 16 and 17 provide unimpeded access to the base for insertion of the fastener 40. The embodiment of Fig. 7 has a channel shape which requires only two bends in a metallic blank to form the brace. That facilitates a lower manufacturing cost and time relative to more complex configurations. Relative dimensions between the side walls, bases, and/or flanges of all embodiments may be selected to achieve desired advantages in moment of inertia and reinforcement while effectively fitting within the dimensions of the particular framework.

[0038] In the preferred embodiment of the invention, the fasteners 40 may be any suitable screw, nail, or staple, such as, for example, 14 gauge x 30 mm long type 17 screw.

[0039] The embodiments of Figures 12, 13 and 14 also offer the advantage of compact, low profile designs which permit stacking/nesting of web members.

[0040] Although the rectangular web members of Figures 4 to 9 and 12 to 15 are preferably formed from wood, and the circular web members of Figures 10, 11, 16 and 17 are preferably formed from metal, the invention is not restricted to these combinations and is suitable for any shape and any material web.

[0041] Furtherstill, in applications of trusses in which conventional framed hip ends, with their trussed roofs, are used, the hip requires to be 120 mm deep, whereas the rest of the truss top chords are 90 mm deep. This means that they have to rip cut the overhang and make a reduction cut at the support point. This is a time consuming and costly operation. The present invention offers the advantage of providing the alternative of using 90 mm hip rafter and fixing a brace 10 to the bottom edge to effectively reinforce the rafter so that it acts like a 120 mm member. Thus, the web members promote efficiency and lower costs by avoiding additional chord sizes and on-site modifications.

[0042] Since modifications within the spirit and scope of the invention may readily be effected by persons skilled within the art, it is to be understood that this invention is not limited to the particular embodiment described by way of example hereinabove.

[0043] When introducing elements of the present invention or the preferred embodiment(s) thereof, the articles "a", "an", "the" and "said" are intended to mean that there are one or more of the elements. The terms "comprising", "including" and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements.